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(54) METHOD FOR PRODUCING A STATOR STACK

(71) We, NIPPONDENSO CO. LTD., a Japanese body corporate, of Kariya-shi, Aichi-ken, Japan, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:

The invention relates to a method for producing a stator stack for electrical machines.

In a previously proposed method winding slots are stamped into a steel sheet strip and the strip is then formed into a helix. The individual coils of the helix are welded together by means of protective gas welding to form a stator stack. The axial end faces of the helix are then pressed to form substantially flat plane-parallel ends. In order to achieve axial alignment of the winding slots of the helix, teeth on the periphery of the coiling device are brought into engagement with the respective winding slots during coiling of the strip. If there is a large number of winding slots, then this method has the disadvantage that projections formed between the winding slots of the strip can both obstruct and damage one another. If the mechanical rigidity of the projections of the strip is low, there is the disadvantage that, even if the projections do not obstruct one another, they are distorted by the teeth of the coiling device.

A further known method for producing a stator stack entails tooth-shaped projections being formed on one edge of the sheet steel strip which is to be coiled to form the stator stack and, in order to align the winding slots of the strip, a toothed wheel of the coiling device engages with said projections. A disadvantage of this method is that an additional operation is required to construct the tooth-shaped projections on the strip. Furthermore, the stator cross section is reduced undesirably by the recesses between the tooth-shaped projections. In order to compensate for this, wider and therefore more expensive sheet steel strip must be sued. In addition, the length of time for the protective gas welding becomes greater and therefore again becomes more expensive.

In accordance with the present invention there is provided a method for producing a stator stack for an electrical machine comprising the steps of: stamping out a plurality of winding slots along one edge of a strip of steel sheet; locally deforming the strip at predetehrmined areas along its length to provide a plurality of projections along one face of the strip and a plurality of corresponding indentations along the opposite face of the strip; winding the strip into a helix so as to align the winding slots to form a plurality of grooves which extend the length of the helix substantially parallel to the longitudinal axis of the helix, the positioning of the projections being such that the or each projection of a coil of the helix engages with a respective indentation of an adjacent coil, except the or each projection on one end coil of the helix which projection faces outwardly of the helix, to form at least one set of projections aligned along a common axis substantially parallel to the axis of the helix; disposing respective electrodes on the projection(s) of said one end coil and on the indentation(s) of the other end coil of the helix and welding together the individual coils of the helix by resistance welding to form the stator stack; and pressing the axial end faces of the helix to form substantially flat plane-parallel ends.

In order to enable as close a connection as possible between the individual coils of the helix during resistance welding, each indentation, in a further embodiment of the invention, comprises an annualr recess and

a blind bore which is concentrically formed in the recess. Moreover, the projection and the corresponding blind bore on the opposite face of the strip are at substantially the same shape, although the projection is larger than the blind bore so that the material of the relevant projection is pressed into both the blind bore and the annular recess of the mating or complementary indentation during welding, thus enlarging the welding point.

The present invention is further described hereinafter, by way of example, with reference to the accompanying drawings, in which: —

Fig. 1 shows a view of a front face of a stator stack;

Fig. 2 shows a side view of the stator stack of Fig. 1;

Fig. 3 shows a portion of a strip of steel sheet provided with winding grooves;

Fig. 4 shows the steel sheet strip of Fig. 3 having centering projections;

Fig. 5 shows a cross section through the steel sheet strip of Fig. 4 along the line V-V in Fig. 4;

Fig. 6 shows a sheet steel strip which is wound into a helix to form a stator stack and which has electrodes disposed on the axial end faces of the stack; and

Fig. 7 shows a resistance-welded stator stack.

Winding slots 2 are stamped out at equal intervals along one edge of a steel sheet strip 1, forming tooth-shaped projections 3 between each adjacent pair of slots 2. The strip 1 is locally deformed at equal intervals along the unstamped base portion 4 of the strip 1 by a pressing action to form centering projections 6 on one face 5 of the strip 1 and corresponding indentations 8 on the opposite face 7 of the strip 1. Each indentation 8 comprises an annular recess 9 in which a blind bore 10 is concentrically formed. The total volume of the indentation 8 is approximately equal to that of the corresponding projection 6. Thus the projection 6 and the corresponding bore 10 are of substantially the same shape but of different volume, the projection 6 being larger than the blind bore 10. The distance between adjacent projections 6 is such that when the strip 1 is wound to form a helix the or each projection 6 on each coil of the helix is aligned with a projection 6 on each adjacent coil of the helix. Thus at least one set of aligned projections 6 is formed with the projections having a common axis extending parallel to the longitudinal axis of the helix. Each projection of all but the last coil of the helix thus engages with a respective indentation on an adjacent coil of the helix.

When the projections 6 are aligned, the slots 2 of the strip are also aligned to form a number of grooves which extend the length of the helix substantially parallel to the axis of the helix.

Electrodes 14 and 15 are now disposed on the centering projections 6 and the indentations 8 on the respective end faces 12 and 13 of the helix. The individual windings of the stator stack 11 are welded together by resistance welding. Each centering projection 6 is pressed into the respective axially adjacent facing indentation 8, so that the individual coils of the helix are pressed together.

Finally the axial end faces 12 and 13 of the stator stack 11 are also pressed to form substantially flat plane-parallel ends.

WHAT WE CLAIM IS: —

1. A method for producing a stator stack for an electrical machine comprising the steps of: stamping out a plurality of winding slots along one edge of a strip of steel sheet; locally deforming the strip at predetermined areas along its length to provide a plurality of projections along one face of the strip and a plurality of corresponding indentations along the opposite face of the strip; winding the strip into a helix so as to align the winding slots to form a plurality of grooves which extend the length of the helix substantially parallel to the longitudinal axis of the helix, the positioning of the projections being such that the or each projection of a coil of the helix engages with a respective indentation of an adjacent coil, except the or each projection on one end coil of the helix which projection faces outwardly of the helix, to form at least one set of projections aligned along a common axis substantially parallel to the axis of the helix; disposing respective electrodes on the projection(s) of said one end coil and on the indentation(s) of the other end coil of the helix and welding together the individual coils of the helix by resistance welding to form the stator stack; and pressing the axial end faces of the helix to form substantially flat plane-parallel ends.

2. A method as claimed in claim 1, wherein each indentation comprises an annular recess and a blind bore concentrically formed in said recess.

3. A method as claimed in claim 2, wherein each projection and the corresponding blind bore on the opposite face of the strip are of substantially the same shape and the projection is larger than said blind bore.

4. A method as claimed in any of claims 1 to 3, wherein the projections and the corresponding indentations are formed at equal intervals along the strip.

5. A method of producing a stator stack substantially as hereinbefore de-

scribed with reference to the accompanying drawings.

6. A stator stack when constructed in accordance with a method as claimed in any of claims 1 to 5.

7. A stator stack according to claim 6 constructed substantially as hereinbefore described with reference to the accompanying drawings.

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2 SHEETS
COMPLETE SPECIFICATION
This drawing is a reproduction of the Original on a reduced scale.
SHEET 1

Fig.1

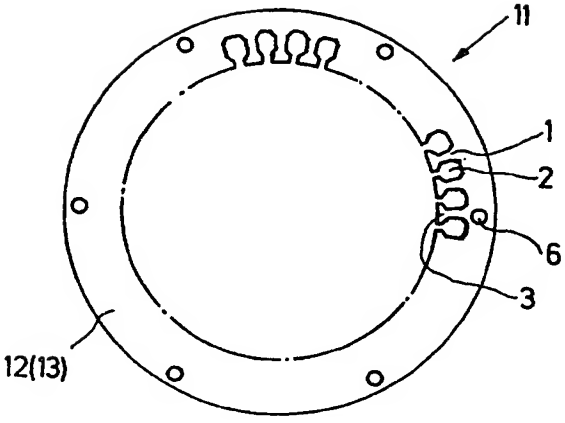

Fig. 2

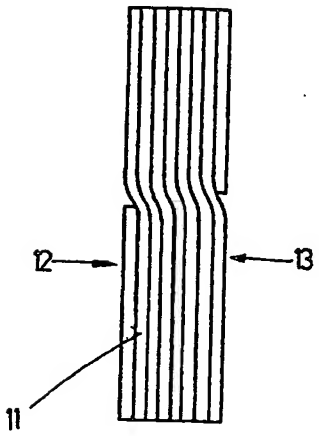

Fig.3

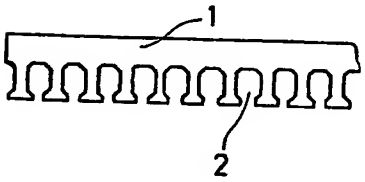

Fig.4

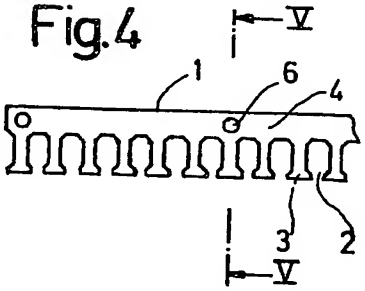

Fig.5

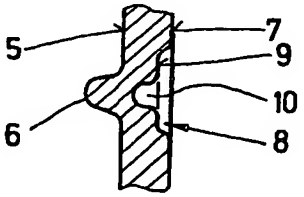

Fig.6

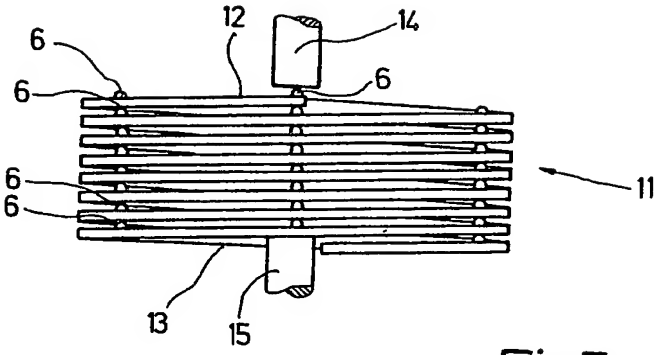

Fig.7